

## Product Overview

The NSi822x devices are high reliability dual-channel digital isolators. The NSi822x device is safety certified by UL1577 support several insulation withstand voltages (3.75kVrms, 5kVrms), while providing high electromagnetic immunity and low emissions at low power consumption. The data rate of the NSi822x is up to 150Mbps, and the common-mode Transient immunity (CMTI) is up to 250kV/us. The NSi822x device provides digital channel direction configuration and the default output level configuration when the input power is lost. Wide supply voltage of the NSi822x device support to connect with most digital interface directly, easy to do the level shift. High system level EMC performance enhance reliability and stability of use. AEC-Q100 (Grade 1) option is provided for all devices.

## Key Features

- Up to 5000V<sub>rms</sub> Insulation voltage
- Data rate: DC to 150Mbps
- Power supply voltage: 2.5V to 5.5V
- All devices are AEC-Q100 qualified
- High CMTI: 250kV/us
- Chip level ESD: HBM: ±8kV
- Robust EMC Reinforced Dual-Channel Digital Isolators for SOW8 wide body and SOW16 wide body
- Default output high level or low-level option
- Isolation surge voltage: >10kV
- Low power consumption: 1.5mA/ch (1 Mbps)
- Low propagation delay: <15ns
- Operation temperature: -40°C~125°C
- RoHS-compliant packages:
  - SOP8 narrow body
  - SOW8 wide body
  - SOW16 wide body

## Safety Regulatory Approvals

- UL recognition: up to 5000V<sub>rms</sub> for 1 minute per UL1577
- CQC certification per GB4943.1-2011
- CSA component notice 5A
- DIN VDE V 0884-11:2017-01

## Applications

- Industrial automation system
- Isolated SPI, RS232, RS485
- General-purpose multichannel isolation
- Motor control

## Device Information

Part Number	Package	Body Size
NSi822xNx-Q1SPR	SOP8	4.90mm × 3.90mm
NSi822xWx-Q1SWVR	SOW8	5.85mm × 7.50mm
NSi822xWx-Q1SWR	SOW16	10.30mm × 7.50mm

## Functional Block Diagrams

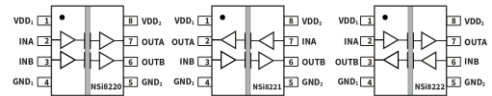


Figure 1. NSi822xN Block Diagram

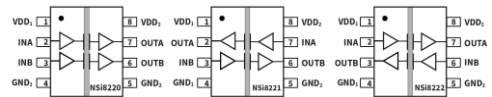


Figure 2. NSi822xW SOW8 Block Diagram

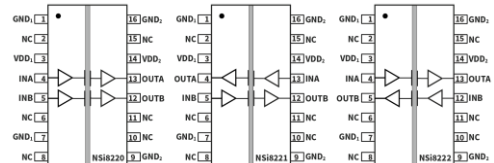


Figure 3. NSi822xW SOW16 Block Diagram

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## 1. Pin Configuration and Functions

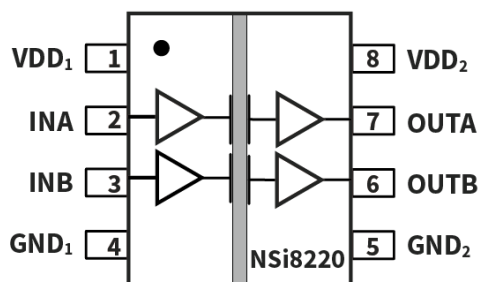


Figure 1.1 NSi8220N Package

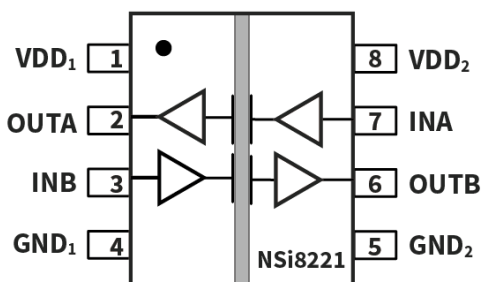


Figure 1.2 NSi8221N Package

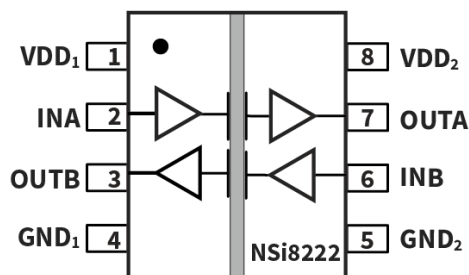


Figure 1.3 NSi8222N Package

Table 1.1 NSi8220N/ NSi8221N/ NSi8222N Pin Configuration and Description

<i>NSi8220N</i> <i>PIN NO.</i>	<i>NSi8221N</i> <i>PIN NO.</i>	<i>NSi8222N</i> <i>PIN NO.</i>	<i>SYMBOL</i>	<i>FUNCTION</i>
1	1	1	VDD1	Power Supply for Isolator Side 1
2	7	2	INA	Logic Input A
3	3	6	INB	Logic Input B
4	4	4	GND1	Ground 1, the ground reference for Isolator Side 1
5	5	5	GND2	Ground 2, the ground reference for Isolator Side 2
6	6	3	OUTB	Logic Output B
7	2	7	OUTA	Logic Output A
8	8	8	VDD2	Power Supply for Isolator Side 2

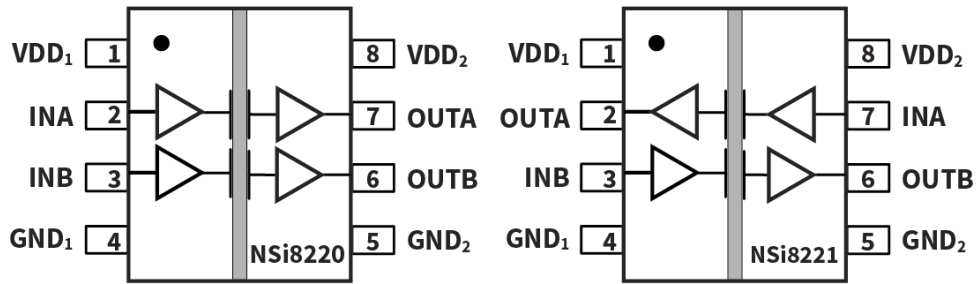


Figure 1.4 NSi8220Wx SOW8 Package

Figure 1.5 NSi8221Wx SOW8 Package

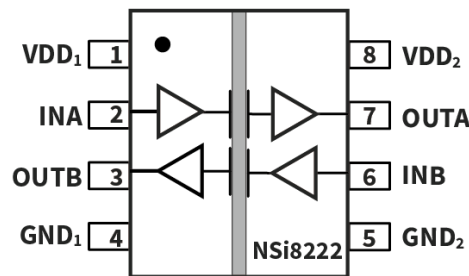


Figure 1.6 NSi8222Wx SOW8 Package

Table 1.2 NSi8220Wx/ NSi8221Wx/ NSi8222Wx SOW Pin Configuration and Description

<i>NSi8220W</i> PIN NO.	<i>NSi8221W</i> PIN NO.	<i>NSi8222W</i> PIN NO.	<i>SYMBOL</i>	<i>FUNCTION</i>
1	1	1	VDD1	Power Supply for Isolator Side 1
2	7	2	INA	Logic Input A
3	3	6	INB	Logic Input B
4	4	4	GND1	Ground 1, the ground reference for Isolator Side 1
5	5	5	GND2	Ground 2, the ground reference for Isolator Side 2
6	6	3	OUTB	Logic Output B
7	2	7	OUTA	Logic Output A
8	8	8	VDD2	Power Supply for Isolator Side 2

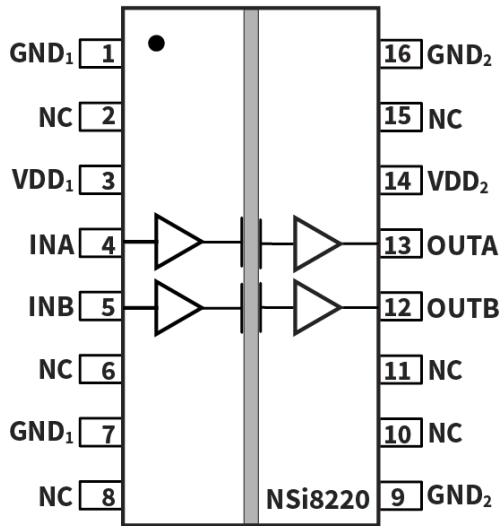


Figure 1.7 NSi8220W Package

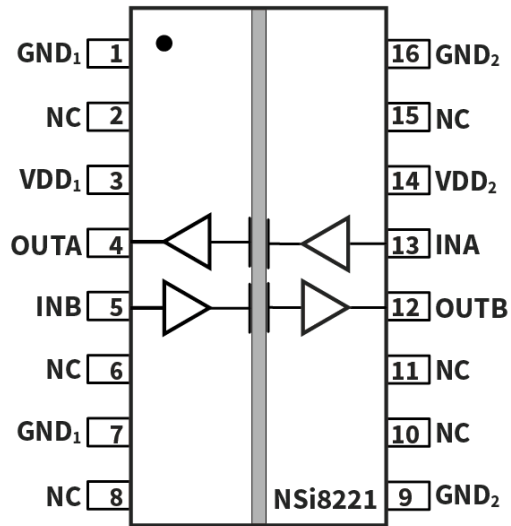


Figure 1.8 NSi8221W Package

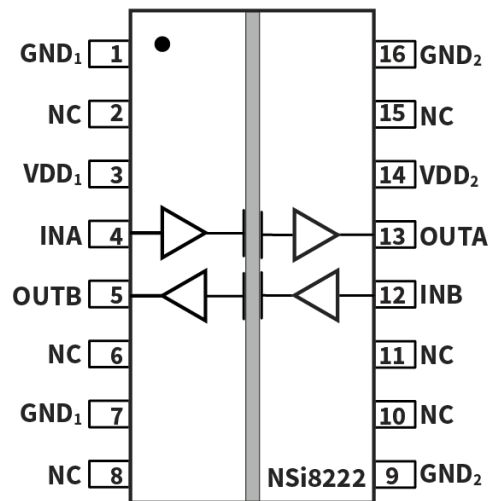


Figure 1.9 NSi8222W Package

Table 1.3 NSi8220W/ NSi8221W/ NSi8222W Pin Configuration and Description

<i>NSi8220W</i> <i>PIN NO.</i>	<i>NSi8221W</i> <i>PIN NO.</i>	<i>NSi8222W</i> <i>PIN NO.</i>	<i>SYMBOL</i>	<i>FUNCTION</i>
1	1	1	GND1	Ground 1, the ground reference for Isolator Side 1
2	2	2	NC	No Connection.
3	3	3	VDD1	Power Supply for Isolator Side 1
4	13	4	INA	Logic Input A

<i>NSi8220W</i> <i>PIN NO.</i>	<i>NSi8221W</i> <i>PIN NO.</i>	<i>NSi8222W</i> <i>PIN NO.</i>	<i>SYMBOL</i>	<i>FUNCTION</i>
5	5	12	INB	Logic Input B
6	6	6	NC	No Connection.
7	7	7	GND1	Ground 1, the ground reference for Isolator Side 1
8	8	8	NC	No Connection.
9	9	9	GND2	Ground 2, the ground reference for Isolator Side 2
10	10	10	NC	No Connection.
11	11	11	NC	No Connection.
12	12	5	OUTB	Logic Output A
13	4	13	OUTA	Logic Output B
14	14	14	VDD2	Power Supply for Isolator Side 2
15	15	15	NC	No Connection.
16	16	16	GND2	Ground 2, the ground reference for Isolator Side 2

## 2. Absolute Maximum Ratings

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Power Supply Voltage	VDD1, VDD2	-0.5		6.5	V	
Maximum Input Voltage	V <sub>INA</sub> , V <sub>INB</sub>	-0.4		VDD+0.4	V	The maximum voltage must not exceed 6.5V
Maximum Output Voltage	V <sub>OUTA</sub> , V <sub>OUTB</sub>	-0.4		VDD+0.4	V	The maximum voltage must not exceed 6.5V
Maximum Input/Output Pulse Voltage	V <sub>INA</sub> , V <sub>INB</sub> , V <sub>OUTA</sub> , V <sub>OUTB</sub>	-0.8		VDD+0.8	V	Pulse width should be less than 100ns, and the duty cycle should be less than 10%
Output current	I <sub>o</sub>	-15		15	mA	
Operating Temperature	T <sub>opr</sub>	-40		125	°C	
Junction Temperature	T <sub>j</sub>			150	°C	
Storage Temperature	T <sub>stg</sub>	-65		150	°C	
Electrostatic discharge	HBM			±8000	V	
	CDM			±2000	V	

## 3. Recommended Operating Conditions

Parameters	Symbol	min	typ	max	unit
Power Supply Voltage	VDD1, VDD2	2.5		5.5	V
Operating Temperature	T <sub>opr</sub>	-40		125	°C
High Level Input Voltage	V <sub>IH</sub>	2			V
Low Level Input Voltage	V <sub>IL</sub>			0.8	V
Data rate	DR			150	Mbps

## 4. Thermal Characteristics

Parameters	Symbol	SOW16	SOW8	SOP8	Unit
IC Junction-to-Air Thermal Resistance	θ <sub>JA</sub>	86.5	84.3	137.7	°C/W

Junction-to-case (top) thermal resistance	$\theta_{JC (top)}$	49.6	36.3	54.9	°C/W
Junction-to-board thermal resistance	$\theta_{JB}$	49.7	47.0	71.7	°C/W

## 5. Specifications

### 5.1. Electrical Characteristics

(VDD1=2.5V~5.5V, VDD2=2.5V~5.5V, Ta=-40°C to 125°C. Unless otherwise noted, Typical values are at VDD1 = 5V, VDD2 = 5V, Ta = 25°C)

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Power on Reset	VDD <sub>POR</sub>		2.2		V	POR threshold as during power-up
	VDD <sub>HYS</sub>		0.1		V	POR threshold Hysteresis
Input Threshold	V <sub>IT</sub>		1.6		V	Input Threshold at rising edge
	V <sub>IT_HYS</sub>		0.4		V	Input Threshold Hysteresis
High Level Input Voltage	V <sub>IH</sub>	2			V	
Low Level Input Voltage	V <sub>IL</sub>			0.8	V	
High Level Output Voltage	V <sub>OH</sub>	VDD-0.4			V	I <sub>OH</sub> ≤ 4mA
Low Level Output Voltage	V <sub>OL</sub>			0.4	V	I <sub>OL</sub> ≤ 4mA
Output Impedance	R <sub>out</sub>		50		ohm	
Input Pull high or low Current	I <sub>pull</sub>		8	15	uA	
Start Up Time after POR	tr <sub>bs</sub>		10		usec	
Common Mode Transient Immunity	CMTI	±200	±250		kV/us	See <a href="#">Figure 5.8</a>



## 5.2. Supply Current Characteristics – 5V Supply

(VDD1=5V± 10%, VDD2=5V± 10%, Ta=-40°C to 125°C. Unless otherwise noted, Typical values are at VDD1 = 5V, VDD2 = 5V, Ta = 25°C)

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Supply current	<b>NSi8220</b>					
	I <sub>DD1</sub> (Q0)		0.59	0.89	mA	All Input 0V for NSi8220x0 Or All Input at supply for NSi8220x1
	I <sub>DD2</sub> (Q0)		1.29	1.94	mA	
	I <sub>DD1</sub> (Q1)		2.80	4.20	mA	All Input at supply for NSi8220x0 Or All Input 0V for NSi8220x1
	I <sub>DD2</sub> (Q1)		1.32	1.98	mA	
	I <sub>DD1</sub> (1M)		1.70	2.55	mA	All Input with 1Mbps, C <sub>L</sub> =15pF
	I <sub>DD2</sub> (1M)		1.39	2.09	mA	
	I <sub>DD1</sub> (10M)		1.78	2.67	mA	All Input with 10Mbps, C <sub>L</sub> =15pF
	I <sub>DD2</sub> (10M)		2.13	3.20	mA	
	I <sub>DD1</sub> (100M)		2.49	4.23	mA	All Input with 100Mbps, C <sub>L</sub> =15pF
	I <sub>DD2</sub> (100M)		9.22	15.66	mA	
	<b>NSi8221/ NSi8222</b>					
	I <sub>DD1</sub> (Q0)		0.94	1.41	mA	All Input 0V for NSi822xx0 Or All Input at supply for NSi822xx1
	I <sub>DD2</sub> (Q0)		0.94	1.41	mA	
	I <sub>DD1</sub> (Q1)		2.06	3.09	mA	All Input at supply for NSi822xx0 Or All Input 0V for NSi822xx1
	I <sub>DD2</sub> (Q1)		2.06	3.09	mA	
	I <sub>DD1</sub> (1M)		1.55	2.32	mA	All Input with 1Mbps, C <sub>L</sub> =15pF
	I <sub>DD2</sub> (1M)		1.55	2.32	mA	
	I <sub>DD1</sub> (10M)		1.96	2.93	mA	All Input with 10Mbps, C <sub>L</sub> =15pF
	I <sub>DD2</sub> (10M)		1.96	2.93	mA	
I <sub>DD1</sub> (100M)		5.86	10.05	mA	All Input with 100Mbps, C <sub>L</sub> = 15pF	
I <sub>DD2</sub> (100M)		5.86	10.05	mA		

5.3. Supply Current Characteristics –3.3V Supply

(VDD1=3.3V± 10%, VDD2=3.3V± 10%, Ta=-40°C to 125°C. Unless otherwise noted, Typical values are at VDD1 = 3.3V, VDD2 = 3.3V, Ta = 25°C)

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Supply current	<b>NSi8220</b>					
	I <sub>DD1</sub> (Q0)		0.56	0.83	mA	All Input 0V for NSi8220x0 Or All Input at supply for NSi8220x1
	I <sub>DD2</sub> (Q0)		1.24	1.86	mA	
	I <sub>DD1</sub> (Q1)		2.76	4.13	mA	All Input at supply for NSi8220x0 Or All Input 0V for NSi8220x1
	I <sub>DD2</sub> (Q1)		1.27	1.91	mA	
	I <sub>DD1</sub> (1M)		1.66	2.49	mA	All Input with 1Mbps, C <sub>L</sub> = 15pF
	I <sub>DD2</sub> (1M)		1.31	1.97	mA	
	I <sub>DD1</sub> (10M)		1.71	2.57	mA	All Input with 10Mbps, C <sub>L</sub> = 15pF
	I <sub>DD2</sub> (10M)		1.80	2.70	mA	
	I <sub>DD1</sub> (100M)		2.20	3.65	mA	All Input with 100Mbps, C <sub>L</sub> = 15pF
	I <sub>DD2</sub> (100M)		6.50	10.77	mA	
	<b>NSi8221/ NSi8222</b>					
	I <sub>DD1</sub> (Q0)		0.90	1.35	mA	All Input 0V for NSi822xx0 Or All Input at supply for NSi822xx1
	I <sub>DD2</sub> (Q0)		0.90	1.35	mA	
	I <sub>DD1</sub> (Q1)		2.01	3.02	mA	All Input at supply for NSi822xx0 Or All Input 0V for NSi822xx1
	I <sub>DD2</sub> (Q1)		2.01	3.02	mA	
	I <sub>DD1</sub> (1M)		1.49	2.23	mA	All Input with 1Mbps, C <sub>L</sub> = 15pF
	I <sub>DD2</sub> (1M)		1.49	2.23	mA	
	I <sub>DD1</sub> (10M)		1.76	2.63	mA	All Input with 10Mbps, C <sub>L</sub> = 15pF
	I <sub>DD2</sub> (10M)		1.76	2.63	mA	
I <sub>DD1</sub> (100M)		4.35	7.27	mA	All Input with 100Mbps, C <sub>L</sub> = 15pF	
I <sub>DD2</sub> (100M)		4.35	7.27	mA		

5.4. Supply Current Characteristics–2.5V Supply

(VDD1=2.5V± 10%, VDD2=2.5V± 10%, Ta=-40°C to 125°C. Unless otherwise noted, Typical values are at VDD1 = 2.5V, VDD2 = 2.5V, Ta = 25°C)

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Supply current	<b>NSi8220</b>					
	I <sub>DD1</sub> (Q0)		0.54	0.81	mA	All Input 0V for NSi8220x0 Or All Input at supply for NSi8220x1
	I <sub>DD2</sub> (Q0)		1.22	1.83	mA	
	I <sub>DD1</sub> (Q1)		2.73	4.10	mA	All Input at supply for NSi8220x0 Or All Input 0V for NSi8220x1
	I <sub>DD2</sub> (Q1)		1.24	1.86	mA	
	I <sub>DD1</sub> (1M)		1.64	2.46	mA	All Input with 1Mbps, C <sub>L</sub> = 15pF
	I <sub>DD2</sub> (1M)		1.27	1.91	mA	
	I <sub>DD1</sub> (10M)		1.67	2.51	mA	All Input with 10Mbps, C <sub>L</sub> = 15pF
	I <sub>DD2</sub> (10M)		1.65	2.48	mA	
	I <sub>DD1</sub> (100M)		1.98	3.23	mA	All Input with 100Mbps, C <sub>L</sub> = 15pF
	I <sub>DD2</sub> (100M)		5.22	8.53	mA	
	<b>NSi8221/ NSi8222</b>					
	I <sub>DD1</sub> (Q0)		0.88	1.32	mA	All Input 0V for NSi822xx0 Or All Input at supply for NSi822xx1
	I <sub>DD2</sub> (Q0)		0.88	1.32	mA	
	I <sub>DD1</sub> (Q1)		1.99	2.98	mA	All Input at supply for NSi822xx0 Or All Input 0V for NSi822xx1
	I <sub>DD2</sub> (Q1)		1.99	2.98	mA	
	I <sub>DD1</sub> (1M)		1.46	2.18	mA	All Input with 1Mbps, C <sub>L</sub> = 15pF
	I <sub>DD2</sub> (1M)		1.46	2.18	mA	
	I <sub>DD1</sub> (10M)		1.66	2.49	mA	All Input with 10Mbps, C <sub>L</sub> = 15pF
	I <sub>DD2</sub> (10M)		1.66	2.49	mA	
I <sub>DD1</sub> (100M)		3.60	5.93	mA	All Input with 100Mbps, C <sub>L</sub> = 15pF	
I <sub>DD2</sub> (100M)		3.60	5.93	mA		

### 5.5. Switching Characteristics - 5V Supply

(VDD1=5V± 10%, VDD2=5V± 10%, Ta=-40°C to 125°C. Unless otherwise noted, Typical values are at VDD1 = 5V, VDD2 = 5V, Ta = 25°C)

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Data Rate	DR	0		150	Mbps	
Minimum Pulse Width	PW			5.0	ns	
Propagation Delay	t <sub>PLH</sub>	2.5	6.54	15	ns	See <a href="#">Figure 5.7</a> , C <sub>L</sub> = 15pF
	t <sub>PHL</sub>	2.5	8.30	15	ns	See <a href="#">Figure 5.7</a> , C <sub>L</sub> = 15pF
Pulse Width Distortion  t <sub>PHL</sub> - t <sub>PLH</sub>	PWD			5.0	ns	See <a href="#">Figure 5.7</a> , C <sub>L</sub> = 15pF
Rising Time	t <sub>r</sub>			5.0	ns	See <a href="#">Figure 5.7</a> , C <sub>L</sub> = 15pF
Falling Time	t <sub>f</sub>			5.0	ns	See <a href="#">Figure 5.7</a> , C <sub>L</sub> = 15pF
Peak Eye Diagram Jitter	t <sub>JIT(PK)</sub>		350		ps	
Channel-to-Channel Delay Skew	t <sub>SK(C2C)</sub>			2.5	ns	
Part-to-Part Delay Skew	t <sub>SK(P2P)</sub>			5.0	ns	

### 5.6. Switching Characteristics - 3.3V Supply

(VDD1=3.3V± 10%, VDD2=3.3V± 10%, Ta=-40°C to 125°C. Unless otherwise noted, Typical values are at VDD1 = 3.3V, VDD2 = 3.3V, Ta = 25°C)

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Data Rate	DR	0		150	Mbps	
Minimum Pulse Width	PW			5.0	ns	
Propagation Delay	t <sub>PLH</sub>	2.5	8.0	15	ns	See <a href="#">Figure 5.7</a> , C <sub>L</sub> = 15pF
	t <sub>PHL</sub>	2.5	8.7	15	ns	See <a href="#">Figure 5.7</a> , C <sub>L</sub> = 15pF
Pulse Width Distortion  t <sub>PHL</sub> - t <sub>PLH</sub>	PWD			5.0	ns	See <a href="#">Figure 5.7</a> , C <sub>L</sub> = 15pF
Rising Time	t <sub>r</sub>			5.0	ns	See <a href="#">Figure 5.7</a> , C <sub>L</sub> = 15pF
Falling Time	t <sub>f</sub>			5.0	ns	See <a href="#">Figure 5.7</a> , C <sub>L</sub> = 15pF
Peak Eye Diagram Jitter	t <sub>JIT(PK)</sub>		350		ps	
Channel-to-Channel Delay Skew	t <sub>SK(C2C)</sub>			2.5	ns	

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Part-to-Part Delay Skew	$t_{sk}(p2p)$			5.0	ns	

### 5.7. Switching Characteristics - 2.5V Supply

(VDD1=2.5V± 10%, VDD2=2.5V± 10%, Ta=-40°C to 125°C. Unless otherwise noted, Typical values are at VDD1 = 2.5V, VDD2 = 2.5V, Ta = 25°C)

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Data Rate	DR	0		150	Mbps	
Minimum Pulse Width	PW			5.0	ns	
Propagation Delay	$t_{PLH}$	2.5	9.0	15	ns	See <a href="#">Figure 5.7</a> , $C_L = 15pF$
	$t_{PHL}$	2.5	9.3	15	ns	See <a href="#">Figure 5.7</a> , $C_L = 15pF$
Pulse Width Distortion $ t_{PHL} - t_{PLH} $	PWD			5.0	ns	See <a href="#">Figure 5.7</a> , $C_L = 15pF$
Rising Time	$t_r$			5.0	ns	See <a href="#">Figure 5.7</a> , $C_L = 15pF$
Falling Time	$t_f$			5.0	ns	See <a href="#">Figure 5.7</a> , $C_L = 15pF$
Peak Eye Diagram Jitter	$t_{JIT}(PK)$		350		ps	
Channel-to-Channel Delay Skew	$t_{sk}(c2c)$			2.5	ns	
Part-to-Part Delay Skew	$t_{sk}(p2p)$			5.0	ns	

5.8. Typical Performance Characteristics

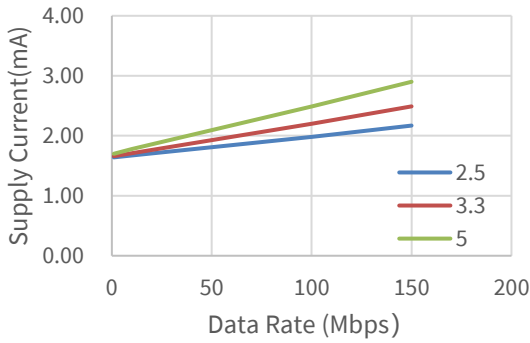


Figure 5.1 NSi8220 VDD1 Supply Current vs Data Rate

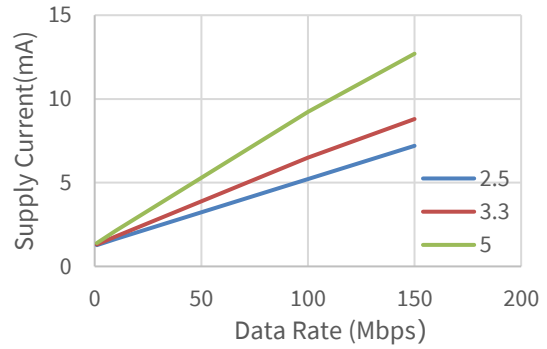


Figure 5.2 NSi8220 VDD2 Supply Current vs Data Rate

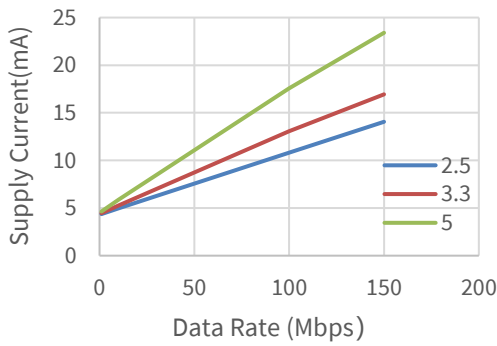


Figure 5.3 NSi8221/ NSi8222 VDD1 Supply Current vs Data Rate

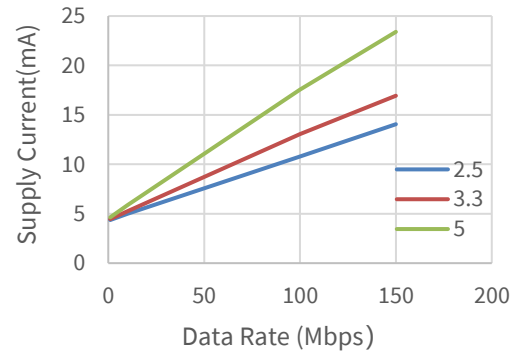


Figure 5.4 NSi8221/ NSi8222 VDD2 Supply Current vs Data Rate

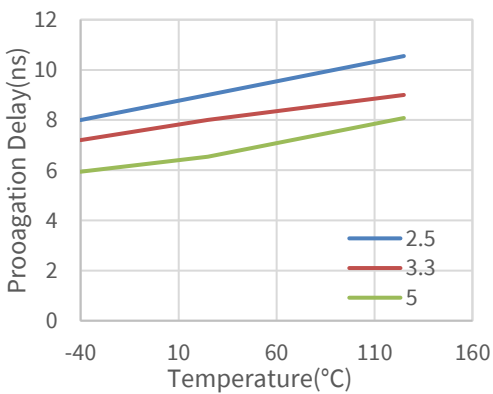


Figure 5.5 Rising Edge Propagation Delay Vs Temp

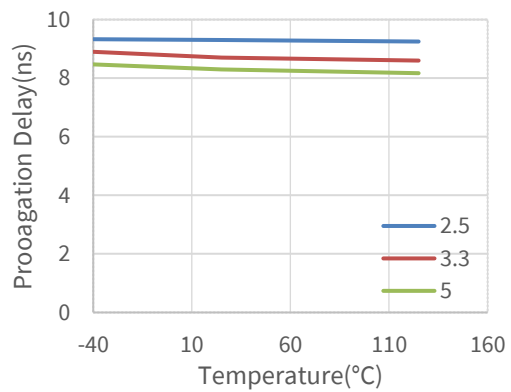


Figure 5.6 Falling Edge Propagation Delay Vs Temp

5.9. Parameter Measurement Information

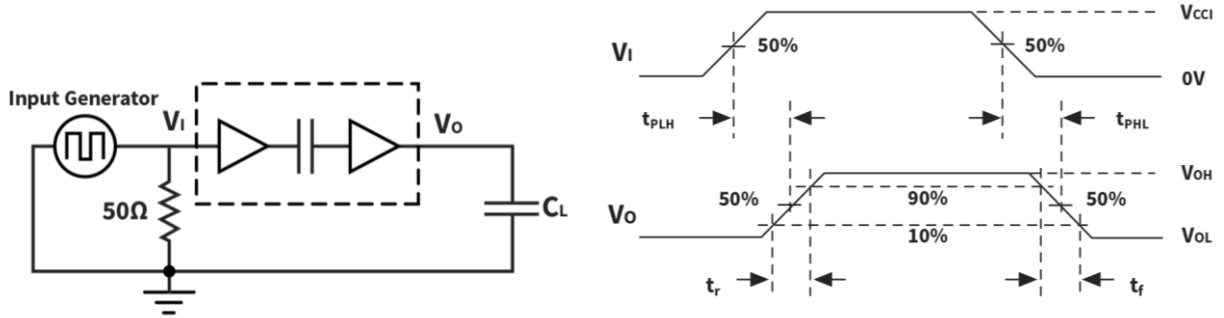


Figure 5.7 Switching Characteristics Test Circuit and Waveform

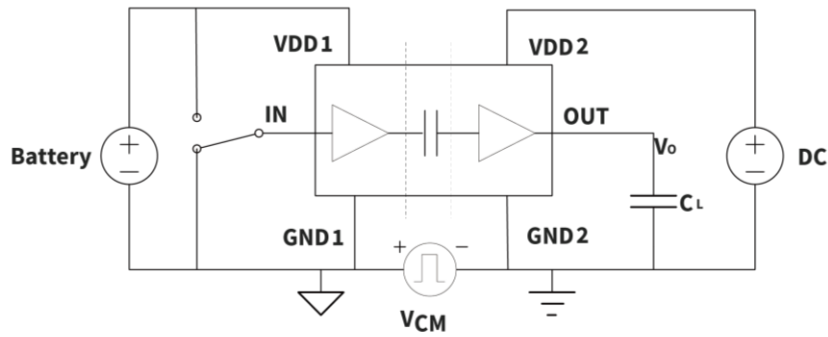


Figure 5.8 Common-Mode Transient Immunity Test Circuit

## 6. High Voltage Feature Description

### 6.1. Insulation and Safety Related Specifications

Description	Test Condition	Symbol	Value			Unit
			SOP8	SOW8	SOW16	
Minimum External Air Gap (Clearance)		CLR	4.0	8.0	8.0	mm
Minimum External Tracking (Creepage)		CPG	4.0	8.0	8.0	mm
Minimum internal gap		DTI	28			um
Tracking Resistance (Comparative Tracking Index)	DIN EN 60112 (VDE 0303-11)	CTI	>400	>600	>600	V
Material Group	IEC 60112		II	I	I	
Installation Classification per DIN VDE 0110						
For Rated Mains Voltage $\leq 150V_{rms}$			I to IV	I to IV	I to IV	
For Rated Mains Voltage $\leq 300V_{rms}$			I to III	I to IV	I to IV	
For Rated Mains Voltage $\leq 600V_{rms}$			I to II	I to IV	I to IV	
For Rated Mains Voltage $\leq 1000V_{rms}$			I	I to III	I to III	
Insulation Specification per DIN VDE V 0884-11:2017-01 <sup>1)</sup>						
Climatic Classification			10/105/21	10/105/21	10/105/21	
Pollution Degree	per DIN VDE 0110, Table 1		2	2	2	
Maximum repetitive isolation voltage		$V_{IORM}$	565	2121	2121	V <sub>peak</sub>
Maximum Working Isolation Voltage	AC voltage	$V_{IOWM}$	400	1500	1500	V <sub>RMS</sub>
	DC voltage		565	2121	2121	V <sub>DC</sub>
Input to Output Test Voltage, Method B1	$V_{IORM} \times 1.5 = V_{pd(m)}$ , 100% production test, $t_{ini} = t_m = 1 \text{ sec}$ , $q_{pd} < 5 \text{ pC}$	$V_{pd(m)}$	847	/	/	V <sub>peak</sub>
	$V_{IORM} \times 1.875 = V_{pd(m)}$ , 100% production test, $t_{ini} = t_m = 1 \text{ sec}$ , $q_{pd} < 5 \text{ pC}$		/	3977	3977	
Input to Output Test Voltage, Method A						



Description	Test Condition	Symbol	Value			Unit
After Environmental Tests Subgroup 1	$V_{IORM} \times 1.3 = V_{pd(m)}$ , $t_{ini} = 60$ sec, $t_m = 10$ sec, $q_{pd} < 5$ pC	$V_{pd(m)}$	678	/	/	Vpeak
	$V_{IORM} \times 1.6 = V_{pd(m)}$ , $t_{ini} = 60$ sec, $t_m = 10$ sec, $q_{pd} < 5$ pC		/	3394	3394	
After Input and /or Safety Test Subgroup 2 and Subgroup 3	$V_{IORM} \times 1.2 = V_{pd(m)}$ , $t_{ini} = 60$ sec, $t_m = 10$ sec, partial discharge $< 5$ pC	$V_{pd(m)}$	678	2545	2545	Vpeak
Maximum Transient isolation voltage	$t = 60$ sec	VIOTM	5300	8000	8000	Vpeak
Maximum Surge Isolation Voltage	Test method per IEC60065, 1.2/50us waveform, $V_{TEST} = V_{IOSM} \times 1.3$	VIOSM	5384			Vpeak
	Test method per IEC60065, 1.2/50us waveform, $V_{TEST} = V_{IOSM} \times 1.6$			6250	6250	Vpeak
Isolation resistance	$V_{IO} = 500V$ at $T_{amb} = T_s$	RIO	$> 10^9$	$> 10^9$	$> 10^9$	$\Omega$
	$V_{IO} = 500V$ at $100^\circ C \leq T_{amb} \leq 125^\circ C$		$> 10^{11}$	$> 10^{11}$	$> 10^{11}$	$\Omega$
Isolation capacitance	$f = 1MHz$	CIO	0.6	0.6	0.6	pF
Insulation Specification per UL1577						
Withstanding isolation voltage	$V_{TEST} = 1.2 \times V_{ISO}$ , $t = 1$ s (100%production)	VISO	3750	5000	5000	$V_{RMS}$

1) This coupler is suitable for “safe electrical insulation” only within the safety ratings. Compliance with the safety ratings shall be ensured by means of suitable protective circuits.

### 6.2. Safety-Limiting Values

Basic isolation safety-limiting values as outlined in VDE-0884-11 of NSi822xN-Q1SPR SOP8(150mil)

Description	Test Condition	Value	Unit
Safety Supply Power	$R_{\theta JA} = 137.7 \text{ }^\circ\text{C/W}$ , $T_J = 150 \text{ }^\circ\text{C}$ , $T_A = 25 \text{ }^\circ\text{C}$	908	mW
Safety Supply Current	$R_{\theta JA} = 137.7 \text{ }^\circ\text{C/W}$ , $V_I = 5.5 \text{ V}$ , $T_J = 150 \text{ }^\circ\text{C}$ , $T_A = 25 \text{ }^\circ\text{C}$	165	mA
Safety Temperature <sup>2)</sup>		150	$^\circ\text{C}$

- 1) Calculate with the junction-to-air thermal resistance,  $R_{\theta JA}$ , of SOP8(150mil) package ([Thermal Information Table](#)) which is that of a device installed on a low effective thermal conductivity test board (1s) according to JESD51-3.
- 2) The maximum safety temperature has the same value as the maximum junction temperature ( $T_J$ ) specified for the device.

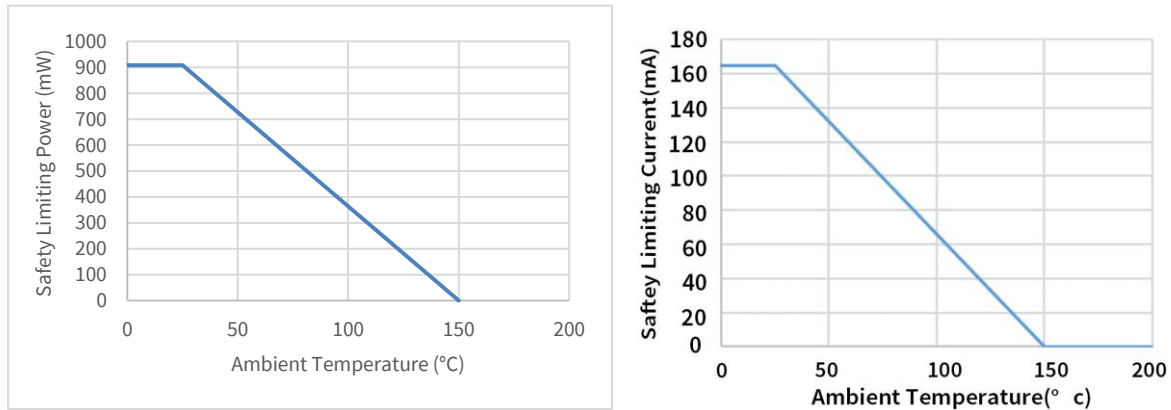


Figure 6.1 NSi822xN-Q1SPR Thermal Derating Curve, Dependence of Safety Limiting Values with Case Temperature per DIN VDE V 0884-11

Reinforced isolation safety-limiting values as outlined in VDE-0884-11 of NSi822xW-Q1SWVR SOW8(300mil)

Description	Test Condition	Value	Unit
Safety Supply Power	$R_{\theta JA} = 84.3 \text{ }^\circ\text{C/W}$ , $V_I = 5.5 \text{ V}$ , $T_J = 150 \text{ }^\circ\text{C}$ , $T_A = 25 \text{ }^\circ\text{C}$	1483	mW
Safety Supply Current	$R_{\theta JA} = 84.3 \text{ }^\circ\text{C/W}$ , $T_J = 150 \text{ }^\circ\text{C}$ , $T_A = 25 \text{ }^\circ\text{C}$	269.6	mA
Safety Temperature <sup>2)</sup>		150	$^\circ\text{C}$

- 1) Calculate with the junction-to-air thermal resistance,  $R_{\theta JA}$ , of SOW8(300mil) package ([Thermal Information Table](#)) which is that of a device installed on a low effective thermal conductivity test board (1s) according to JESD51-3.
- 2) The maximum safety temperature has the same value as the maximum junction temperature ( $T_J$ ) specified for the device.

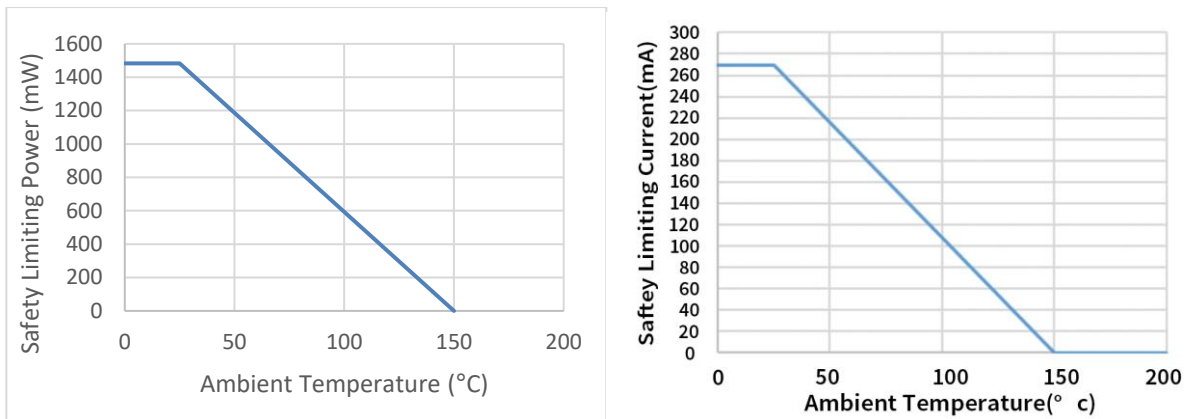


Figure 6.2 NSi822xW-Q1SWR Thermal Derating Curve, Dependence of Safety Limiting Values with Case Temperature per DIN VDE V 0884-11

Reinforced isolation safety-limiting values as outlined in VDE-0884-11 of NSi822xW-Q1SWR SOW16(300mil)

Description	Test Condition	Value	Unit
Safety Supply Power	$R_{\theta JA} = 86.5 \text{ }^\circ\text{C/W}$ , $V_I = 5.5 \text{ V}$ , $T_J = 150 \text{ }^\circ\text{C}$ , $T_A = 25 \text{ }^\circ\text{C}$	1445	mW
Safety Supply Current	$R_{\theta JA} = 86.5 \text{ }^\circ\text{C/W}$ , $T_J = 150 \text{ }^\circ\text{C}$ , $T_A = 25 \text{ }^\circ\text{C}$	262.7	mA
Safety Temperature <sup>2)</sup>		150	$^\circ\text{C}$

- 1) Calculate with the junction-to-air thermal resistance,  $R_{\theta JA}$ , of SOW16(300mil) package ([Thermal Information Table](#)) which is that of a device installed on a low effective thermal conductivity test board (1s) according to JESD51-3.
- 2) The maximum safety temperature has the same value as the maximum junction temperature ( $T_J$ ) specified for the device.

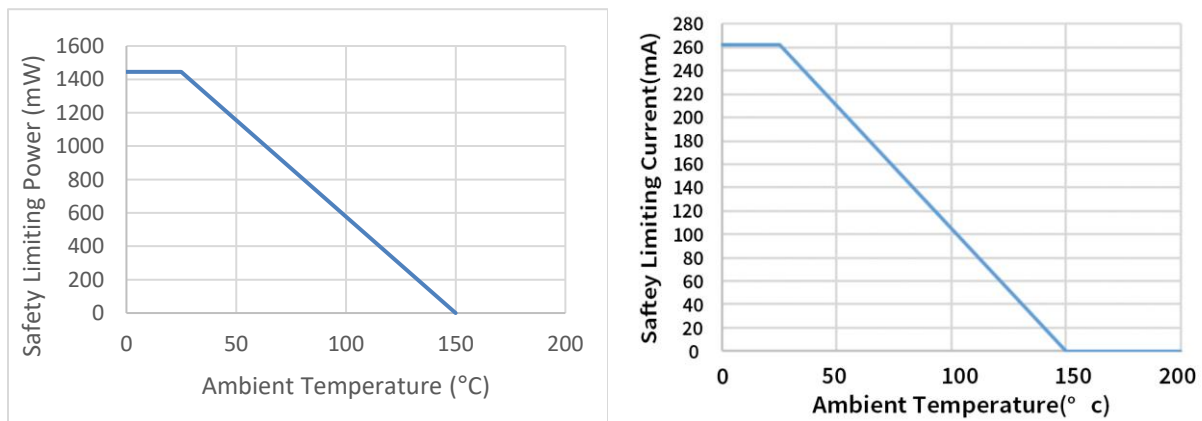


Figure 6.3 NSi822xW-Q1SWR Thermal Derating Curve, Dependence of Safety Limiting Values with Case Temperature per DIN VDE V 0884-11

### 6.3. Regulatory Information

The NSi822xN-Q1SPR are approved by the organizations listed in table.

<i>CUL</i>		<i>VDE</i>	<i>CQC</i>
UL 1577 Component Recognition Program	Approved under CSA Component Acceptance Notice 5A	DIN VDE V 0884-11:2017-01	Certified by CQC11-471543-2012 GB4943.1-2011
Single Protection, 3750V <sub>rms</sub> Isolation voltage	Single Protection, 3750V <sub>rms</sub> Isolation voltage	Basic Insulation 565V <sub>peak</sub> , V <sub>IOSM</sub> =5384V <sub>peak</sub>	Basic insulation
File (E500602)	File (E500602)	File (40050121)	File (CQC20001264940)

The NSi822xW-Q1SWVR are approved by the organizations listed in table.

<i>CUL</i>		<i>VDE</i>	<i>CQC</i>
UL 1577 Component Recognition Program	Approved under CSA Component Acceptance Notice 5A	DIN VDE V 0884-11(VDE V 0884-11):2017-01	Certified by CQC11-471543-2012 GB4943.1-2011
Single Protection, 5000V <sub>rms</sub> Isolation voltage	Single Protection, 5000V <sub>rms</sub> Isolation voltage	Reinforced Insulation 2121V <sub>peak</sub> , V <sub>IOSM</sub> =6250V <sub>peak</sub>	Reinforced insulation
File (E500602)	File (E500602)	File (40052820)	File (CQC20001264938)

The NSi822xW-Q1SWR are approved by the organizations listed in table.

<i>CUL</i>		<i>VDE</i>	<i>CQC</i>
UL 1577 Component Recognition Program	Approved under CSA Component Acceptance Notice 5A	DIN VDE V 0884-11(VDE V 0884-11):2017-01	Certified by CQC11-471543-2012 GB4943.1-2011
Single Protection, 5000V <sub>rms</sub> Isolation voltage	Single Protection, 5000V <sub>rms</sub> Isolation voltage	Reinforced Insulation 2121V <sub>peak</sub> , V <sub>IOSM</sub> =6250V <sub>peak</sub>	Reinforced insulation
File (E500602)	File (E500602)	File (40052820)	File (CQC20001264939)

## 7. Function Description

### 7.1. Overview

The NSi822x is a Dual-channel digital isolator based on a capacitive isolation barrier technique. The digital signal is modulated with RF carrier generated by the internal oscillator at the Transmitter side. Then it is transferred through the capacitive isolation barrier and demodulated at the Receiver side.

The NSi822x devices are high reliability dual-channel digital isolator with AEC-Q100 qualified. The NSi822x device is safety certified by UL1577 support several insulation withstand voltages (3.75kV<sub>rms</sub>, 5kV<sub>rms</sub>), while providing high electromagnetic immunity and low emissions at low power consumption. The data rate of the NSi822x is up to 150Mbps, and the common-mode Transient immunity (CMTI) is up to 250kV/us. The NSi822x device provides digital channel direction configuration and the default output level configuration when the input power is lost. Wide supply voltage of the NSi822x device support to connect with most digital interface directly, easy to do the level shift. High system level EMC performance enhance reliability and stability of use.

The NSi822x has a default output status when VDDIN is unready and VDDOUT is ready as shown in Table 4.1, which helps for diagnosis when power is missing at the transmitter side. The output B follows the same status with the input A within 60us after powering up.

Table 7.1 Output status vs. power status

Input	VDD1 status	VDD2 status	Output	Comment
H <sup>1</sup>	Ready	Ready	H	Normal operation.
L <sup>2</sup>	Ready	Ready	L	
X <sup>3</sup>	Unready	Ready	L(NSi822xx0) H(NSi822xx1)	The output follows the same status with the input within 60us after input side VDD1 is powered on.
X	Ready	Unready	X	The output follows the same status with the input within 60us after output side VDD2 is powered on.
Note: H=Logic high; L=Logic low; X=Logic low or logic high VDD1 is input side power;VDD2 is out side power.				

### 7.2. OOK Modulation

NSi822x is based on a capacitive isolation barrier technique and the digital signal is modulated with RF carrier generated by the internal oscillator at the transmitter side, as shown in Figure 7.1, then it is transferred through the capacitive isolation barrier and demodulated at the receiver side. The modulation uses OOK modulation technique with key benefits of high noise immunity and low radiation EMI.

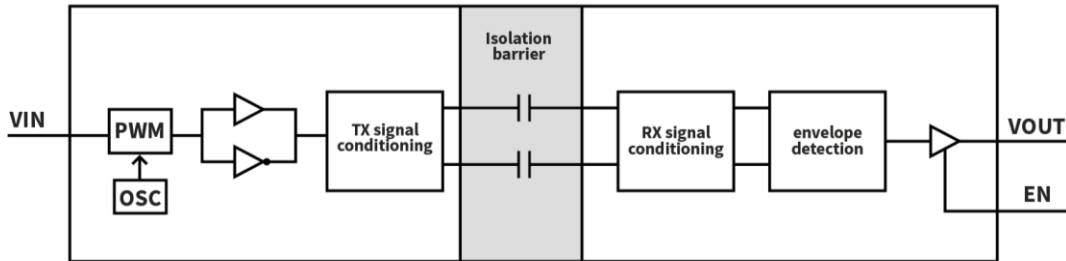


Figure 7.1 Single Channel Function Block Diagram

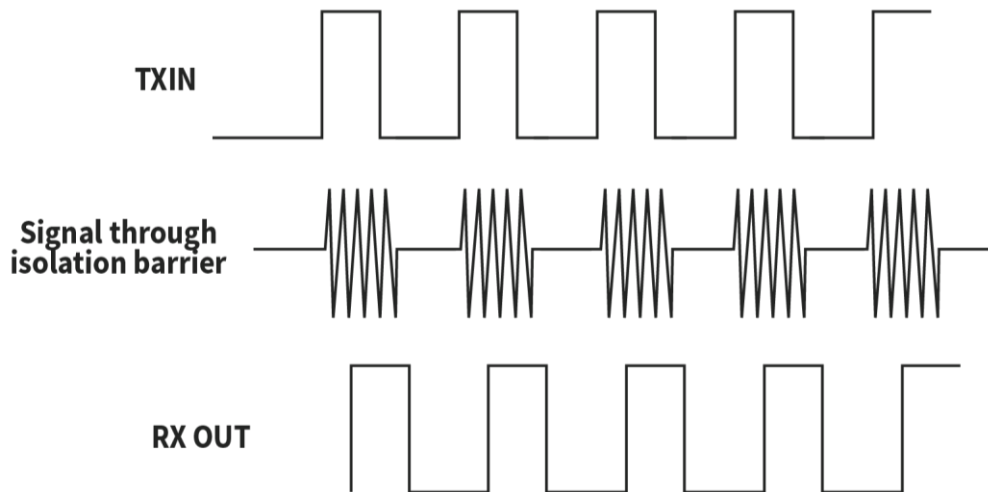


Figure 7.2 OOK Modulation

## 8. Application Note

### 8.1. Typical Application Circuit

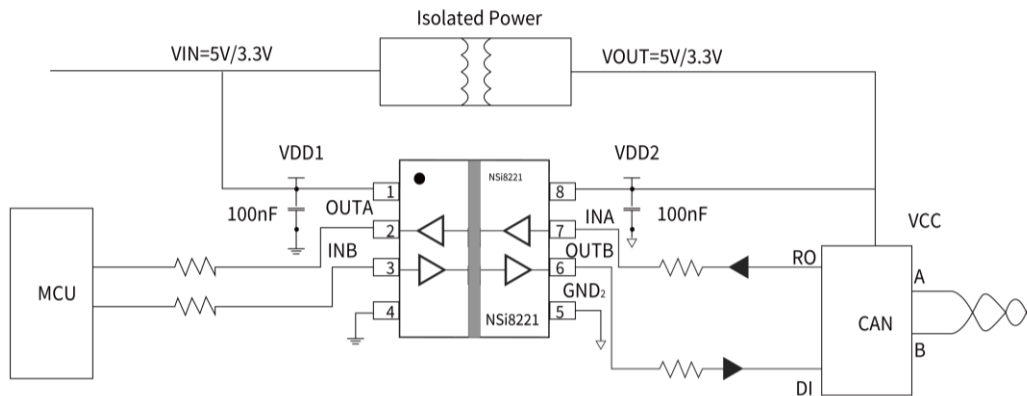


Figure 8.1 Typical SCH for ISO CAN Interface

### 8.2. PCB Layout

The NSi822x requires a 0.1  $\mu$ F bypass capacitor between VDD1 and GND1, VDD2 and GND2. The capacitor should be placed as close as possible to the package. Figure 8.2 to Figure 8.5 show the recommended PCB layout, make sure the space under the chip should keep free from planes, traces, pads and via. To enhance the robustness of a design, the user may also include resistors (50–300  $\Omega$ ) in series with the inputs and outputs if the system is excessively noisy. The series resistors also improve the system reliability such as latch-up immunity.

The typical output impedance of an isolator driver channel is approximately 50  $\Omega$ ,  $\pm 40\%$ . When driving loads where transmission line effects will be a factor, output pins should be appropriately terminated with controlled impedance PCB traces.

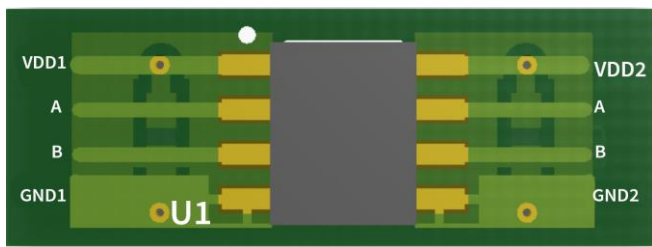


Figure8.2 Recommended PCB Layout — Top Layer

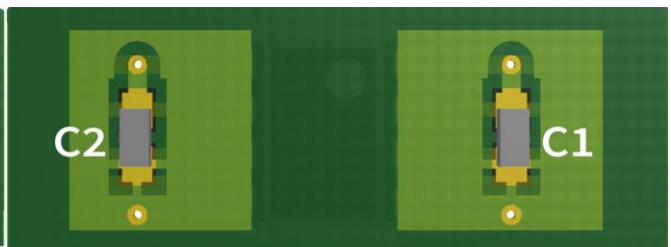


Figure8.3 Recommended PCB Layout — Bottom Layer

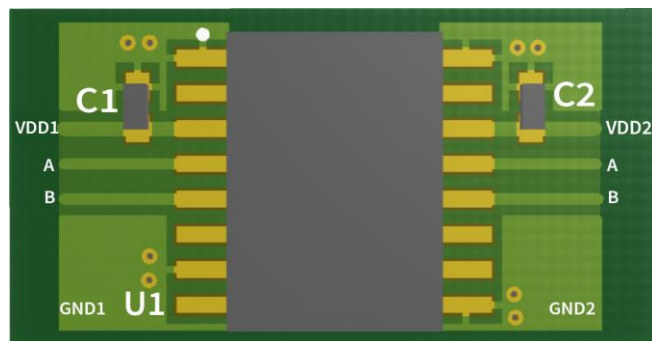


Figure8.4 Recommended PCB Layout — Top Layer

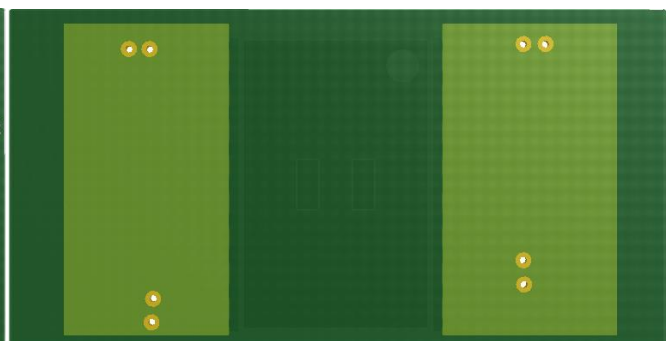


Figure8.5 Recommended PCB Layout — Bottom Layer

### 8.3. High Speed Performance

Figure 8.6 shows the eye diagram of NSi822x at 200Mbps data rate output. The result shows a typical measurement on the NSi822x with 350ps p-p jitter.

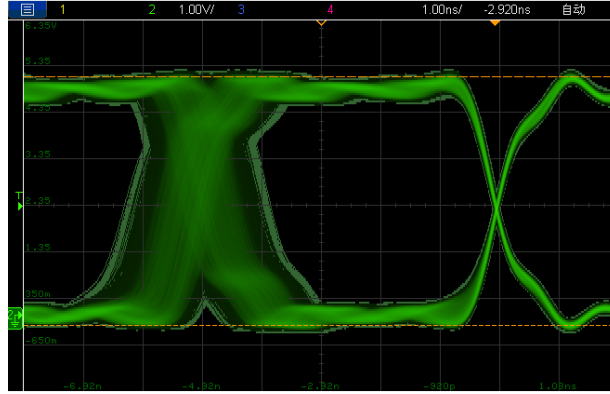


Figure8.6 NSi822x Eye Diagram

### 8.4. Typical Supply Current Equations

The typical supply current of NSi822x can be calculated using below equations.  $I_{DD1}$  and  $I_{DD2}$  are typical supply currents measured in mA,  $f$  is data rate measured in Mbps,  $C_L$  is the capacitive load measured in pF

**NSi8220:**

$$I_{DD1} = 0.19 * a1 + 1.45 * b1 + 0.82 * c1.$$

$$I_{DD2} = 1.36 + VDD1 * f * C_L * c1 * 10^{-9}$$

When  $a1$  is the channel number of low input at side 1,  $b1$  is the channel number of high input at side 1,  $c1$  is the channel number of switch signal input at side 1.

**NSi8221/ NSi8222:**

$$I_{DD1} = 0.87 + 1.26 * b1 + 0.63 * c1 + VDD1 * f * C_L * c2 * 10^{-9}$$

$$I_{DD2} = 0.87 + 1.26 * b2 + 0.63 * c2 + VDD1 * f * C_L * c1 * 10^{-9}$$

When  $b1$  is the channel number of high input at side 1,  $c1$  is the channel number of switch signal input at side 1,  $b2$  is the channel number of high input at side 2,  $c2$  is the channel number of switch signal input at side 2.



9. Package Information

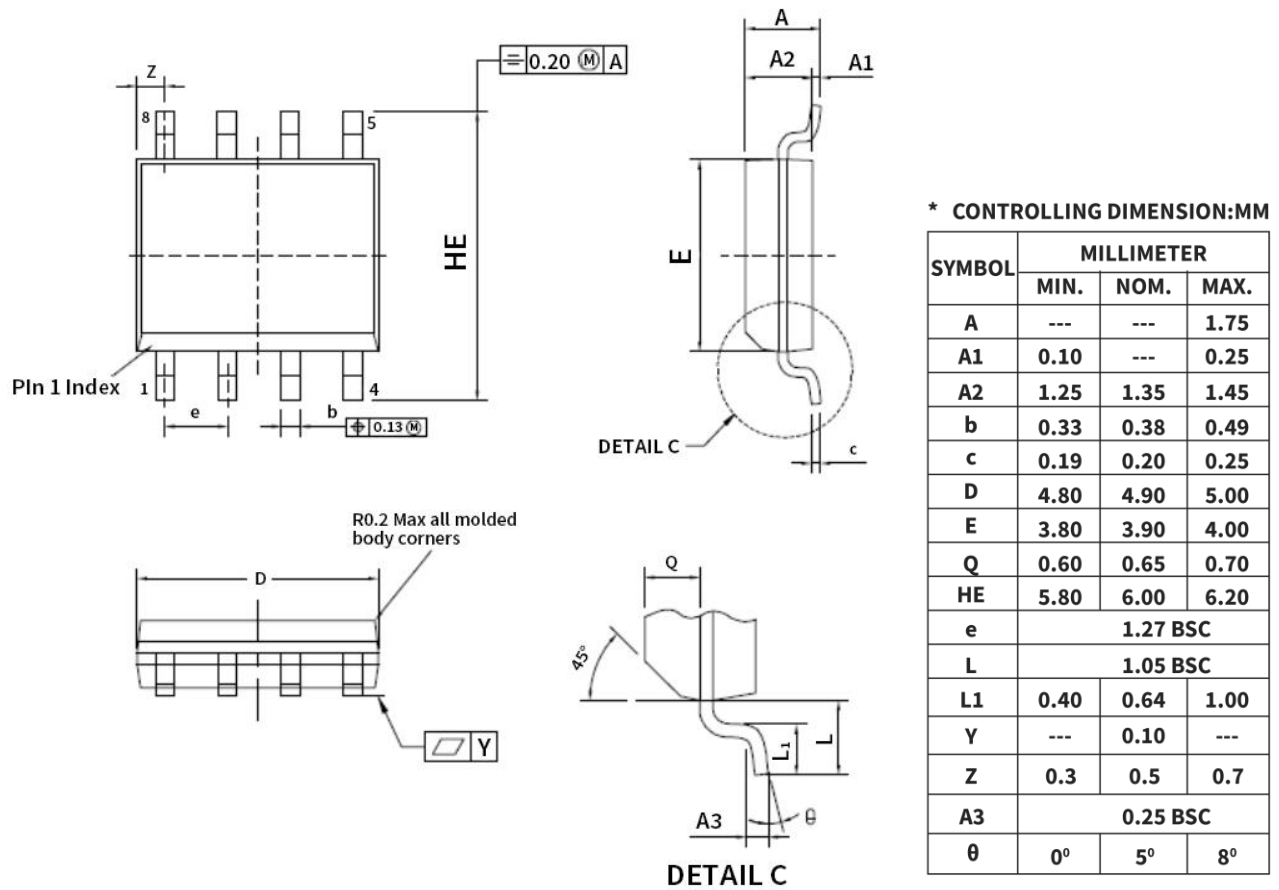
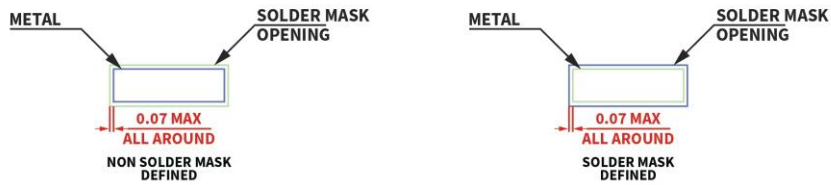
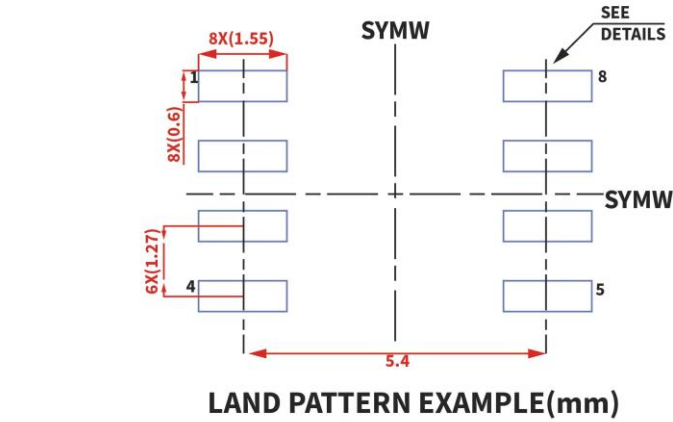


Figure 9.1 SOP8 Package Shape and Dimension in millimeters



SOLDER MASK DETAILS

Figure 9.2 SOP8 Package Board Layout Example

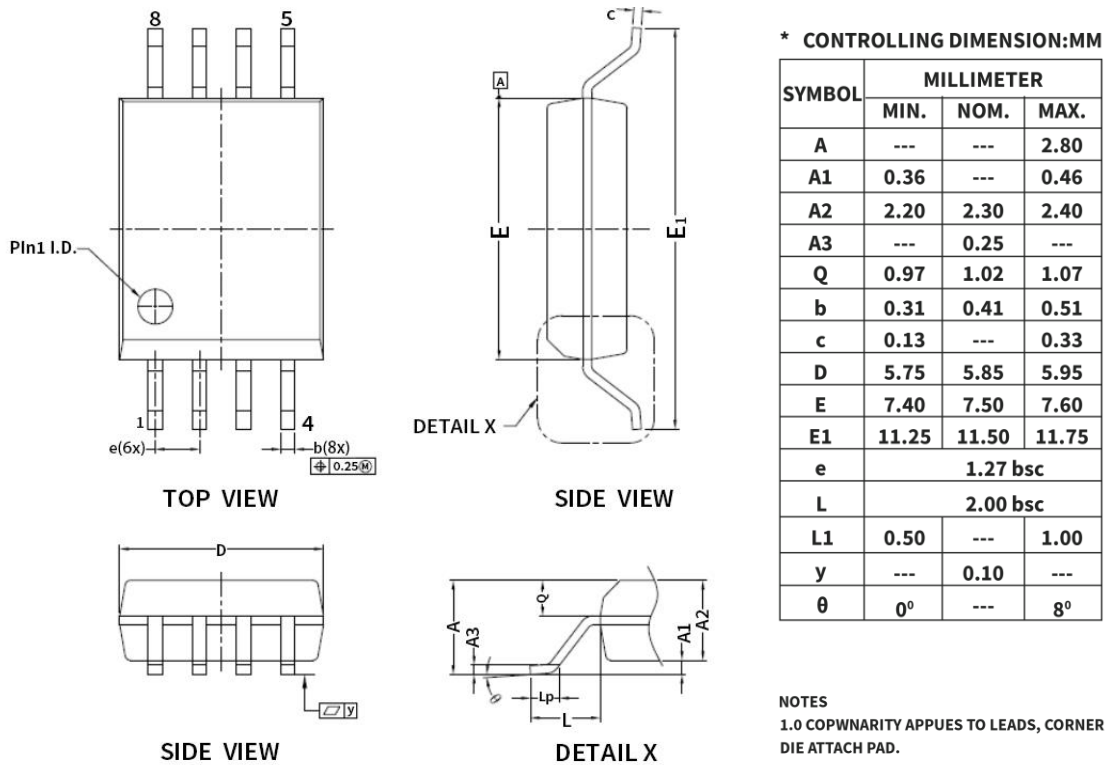
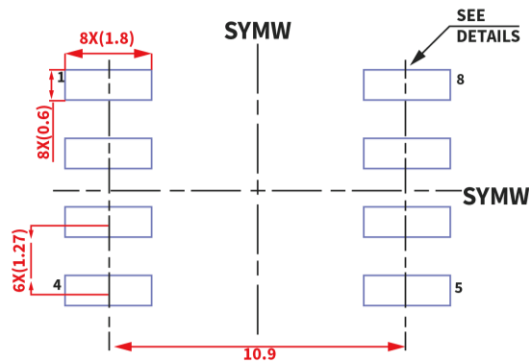
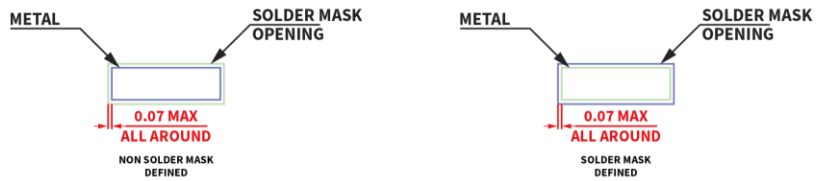


Figure 9.3 SOW8 Package Shape and Dimension in millimeters

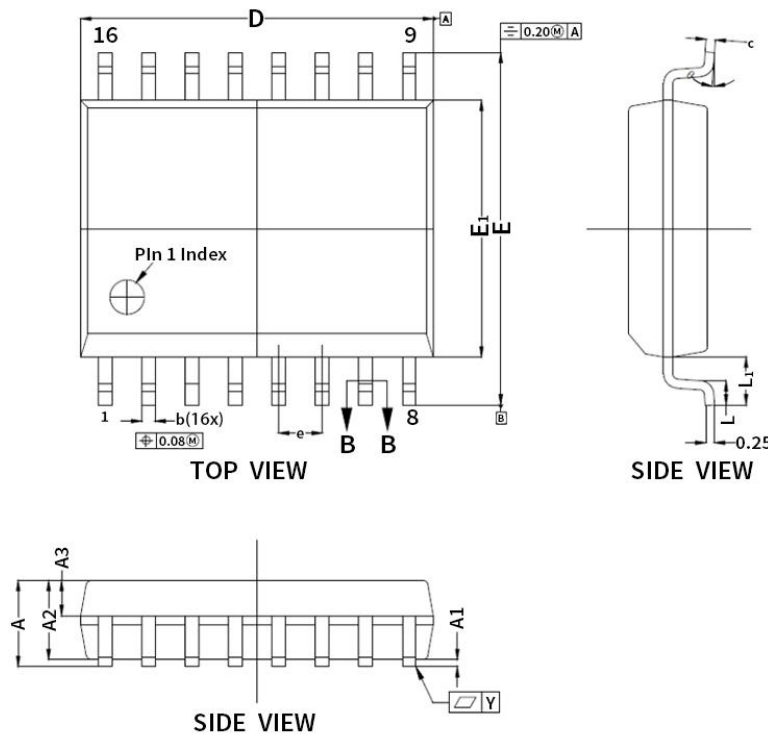


**LAND PATTERN EXAMPLE(mm)  
9.1mm NOMINAL  
CLEARANCE/CREEPAGE**



**SOLDER MASK DETAILS**

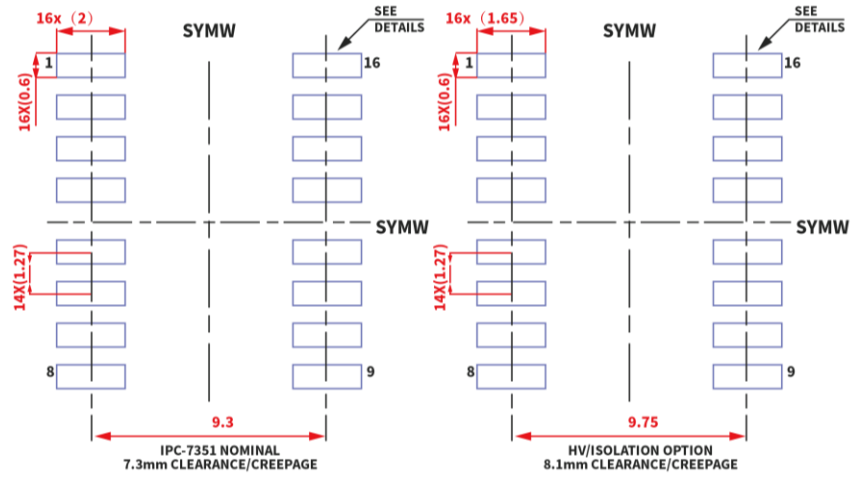
Figure 9.4 SOW8 Package Board Layout Example



\* CONTROLLING DIMENSION:MM

SYMBOL	MILLIMETER		
	MIN.	NOM.	MAX.
A	---	---	2.65
A1	0.10	---	0.30
A2	2.25	2.30	2.35
A3	0.97	1.02	1.07
b	0.35	---	0.43
c	0.23	---	0.32
D	10.20	10.30	10.40
E	10.10	10.30	10.50
E1	7.40	7.50	7.60
e	1.27 bsc		
L1	1.40 bsc		
L	0.55	---	0.85
Y	---	0.10	---
θ	0°	---	8°

Figure 9.5 SOW16 Package Shape and Dimension in millimeters



LAND PATTERN EXAMPLE(mm)



SOLDER MASK DETAILS

Figure 9.6 SOW16 Package Board Layout Example

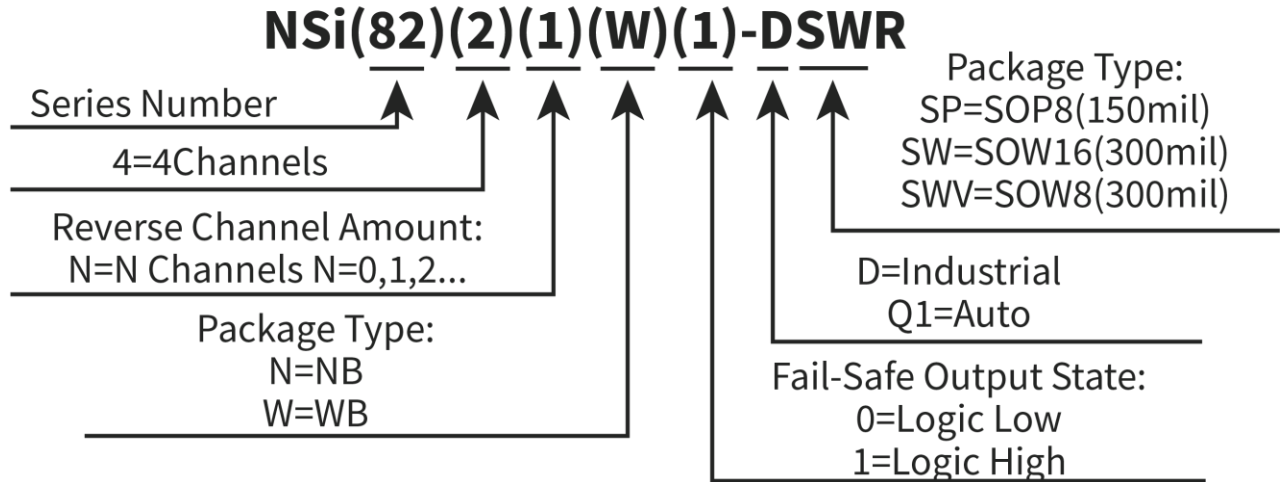
## 10. Order Information

Part Number	Isolation Rating (kV)	Number of side 1 inputs	Number of side 2 inputs	Max Data Rate (Mbps)	Default Output State	Temperature	MSL	Package Type	Package Drawing	SPQ
NSi8220N0-Q1SPR	3.75	2	0	150	Low	-40 to 125 °C	1	SOP8 (150mil)	SOP8	2500
NSi8220N1-Q1SPR	3.75	2	0	150	High	-40 to 125 °C	1	SOP8 (150mil)	SOP8	2500
NSi8221N0-Q1SPR	3.75	1	1	150	Low	-40 to 125 °C	1	SOP8 (150mil)	SOP8	2500
NSi8221N1-Q1SPR	3.75	1	1	150	High	-40 to 125 °C	1	SOP8 (150mil)	SOP8	2500
NSi8222N0-Q1SPR	3.75	1	1	150	Low	-40 to 125 °C	1	SOP8 (150mil)	SOP8	2500
NSi8222N1-Q1SPR	3.75	1	1	150	High	-40 to 125 °C	1	SOP8 (150mil)	SOP8	2500
NSi8220W0-Q1SWR	5	2	0	150	Low	-40 to 125 °C	2	SOW16 (300mil)	SOW16	1000
NSi8220W1-Q1SWR	5	2	0	150	High	-40 to 125 °C	2	SOW16 (300mil)	SOW16	1000
NSi8221W0-Q1SWR	5	1	1	150	Low	-40 to 125 °C	2	SOW16 (300mil)	SOW16	1000

Part Number	Isolation Rating (kV)	Number of side 1 inputs	Number of side 2 inputs	Max Data Rate (Mbps)	Default Output State	Temperature	MSL	Package Type	Package Drawing	SPQ
NSi8221W1-Q1SWR	5	1	1	150	High	-40 to 125 °C	2	SOW16 (300mil)	SOW16	1000
NSi8222W0-Q1SWR	5	1	1	150	Low	-40 to 125 °C	2	SOW16 (300mil)	SOW16	1000
NSi8222W1-Q1SWR	5	1	1	150	High	-40 to 125 °C	2	SOW16 (300mil)	SOW16	1000
NSi8220W0-Q1SWVR	5	2	0	150	Low	-40 to 125 °C	3	SOW8 (300mil)	SOW8	1000
NSi8220W1-Q1SWVR	5	2	0	150	High	-40 to 125 °C	3	SOW8 (300mil)	SOW8	1000
NSi8221W0-Q1SWVR	5	1	1	150	Low	-40 to 125 °C	3	SOW8 (300mil)	SOW8	1000
NSi8221W1-Q1SWVR	5	1	1	150	High	-40 to 125 °C	3	SOW8 (300mil)	SOW8	1000
NSi8222W0-Q1SWVR	5	1	1	150	Low	-40 to 125 °C	3	SOW8 (300mil)	SOW8	1000
NSi8222W1-Q1SWVR	5	1	1	150	High	-40 to 125 °C	3	SOW8 (300mil)	SOW8	1000

NOTE: All packages are RoHS-compliant with peak reflow temperatures of 260 °C according to the JEDEC industry standard classifications and peak solder temperatures.  
All devices are AEC-Q100 qualified.

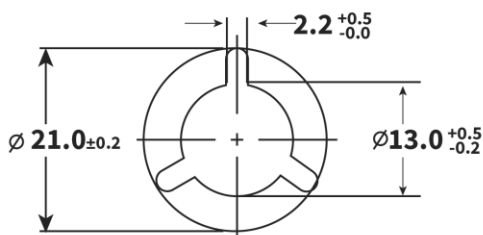
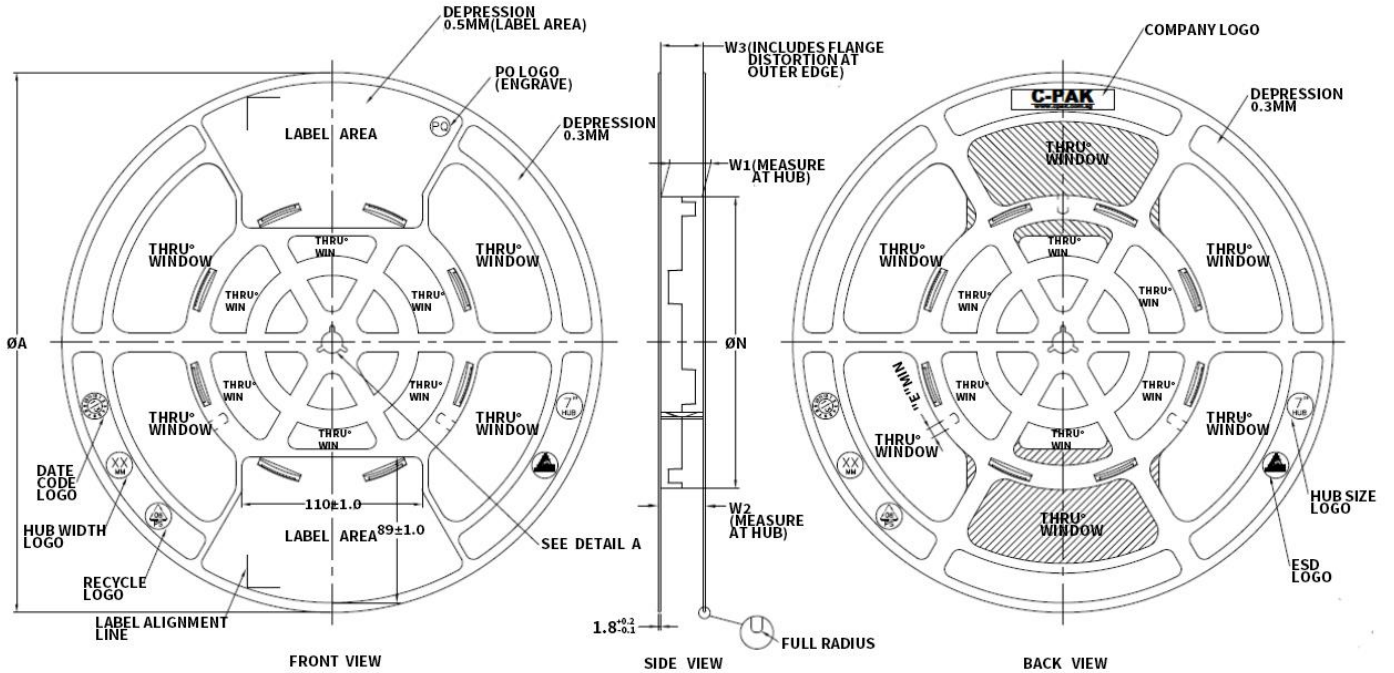
Part Number Rule:



11. Documentation Support

Part Number	Product Folder	Datasheet	Technical Documents	Isolator selection guide
NSi822x	tbd	tbd	tbd	tbd

## 12. Tape and Reel Information



**ARBOR HOLE  
DETAIL A  
SCALE: 3:1**

PRODUCT SPECIFICATION						
TAPE WIDTH	$\varnothing A$ $\pm 2.0$	$\varnothing N$ $\pm 2.0$	W1	W2 (Max)	W3	E (MIN)
08MM	330	178	8.4 <sup>+1.5</sup> <sub>-0.0</sub>	14.4	SHALL ACCOMMODATE TAPE WIDTH WITHOUT INTERFERENCE	5.5
12MM	330	178	12.4 <sup>+2.0</sup> <sub>-0.0</sub>	18.4		5.5
16MM	330	178	16.4 <sup>+2.0</sup> <sub>-0.0</sub>	22.4		5.5
24MM	330	178	24.4 <sup>+2.0</sup> <sub>-0.0</sub>	30.4		5.5
32MM	330	178	32.4 <sup>+2.0</sup> <sub>-0.0</sub>	38.4		5.5

SURFACE RESISTIVITY			
LEGEND	SR RANGE	TYPE	COLOUR
A	BELOW $10^{12}$	ANTISTATIC	ALL TYPES
B	$10^5$ TO $10^{11}$	STATIC DISSIPATIVE	BLACK ONLY
C	$10^5$ & BELOW $10^5$	CONDUCTIVE(GENERIC)	BLACK ONLY
E	$10^9$ TO $10^{11}$	ANTISTATIC(COATED)	ALL TYPES

Figure 12.1 Reel Information (for all packages)

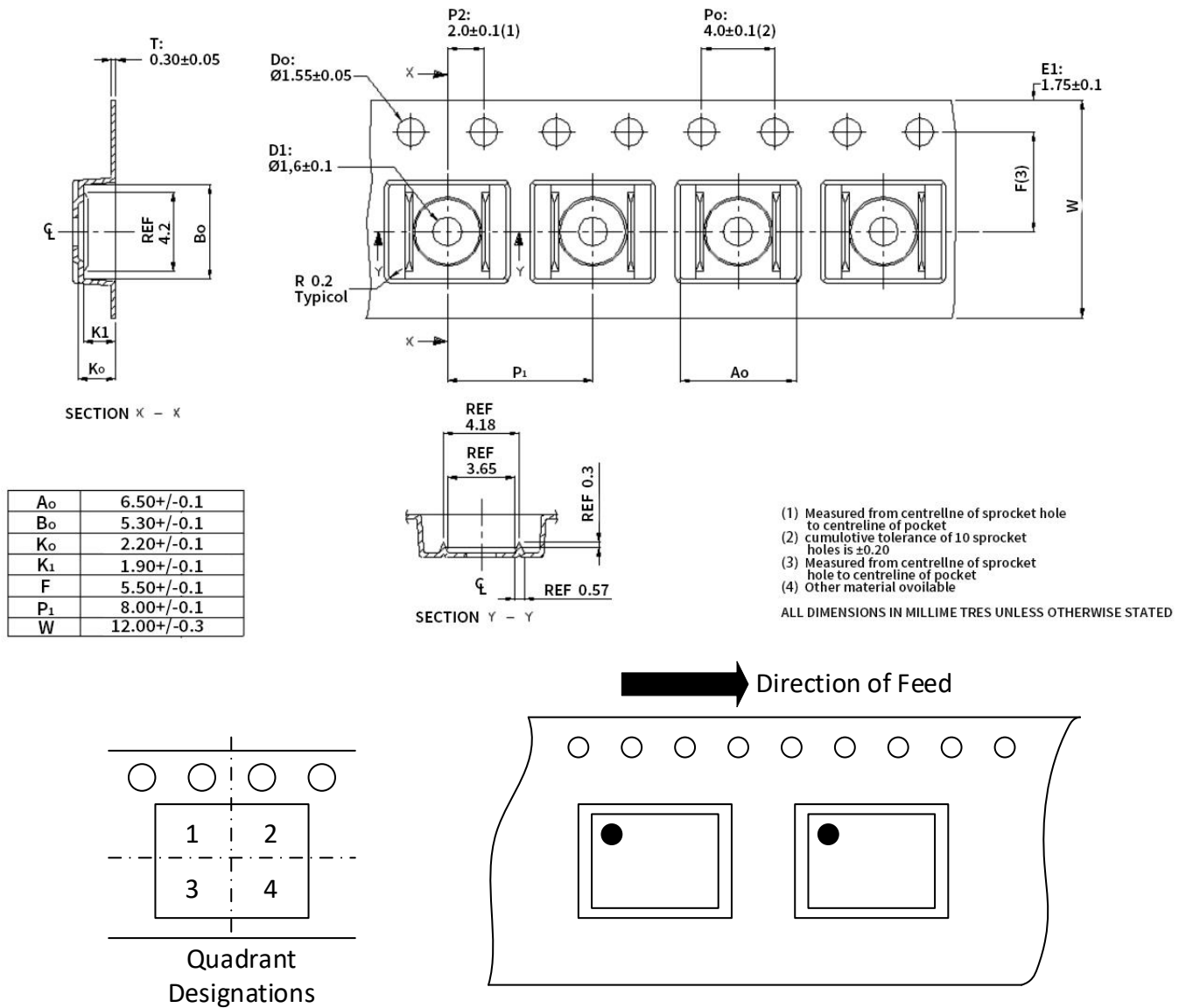


Figure 12.2 Tape Information of SOP8



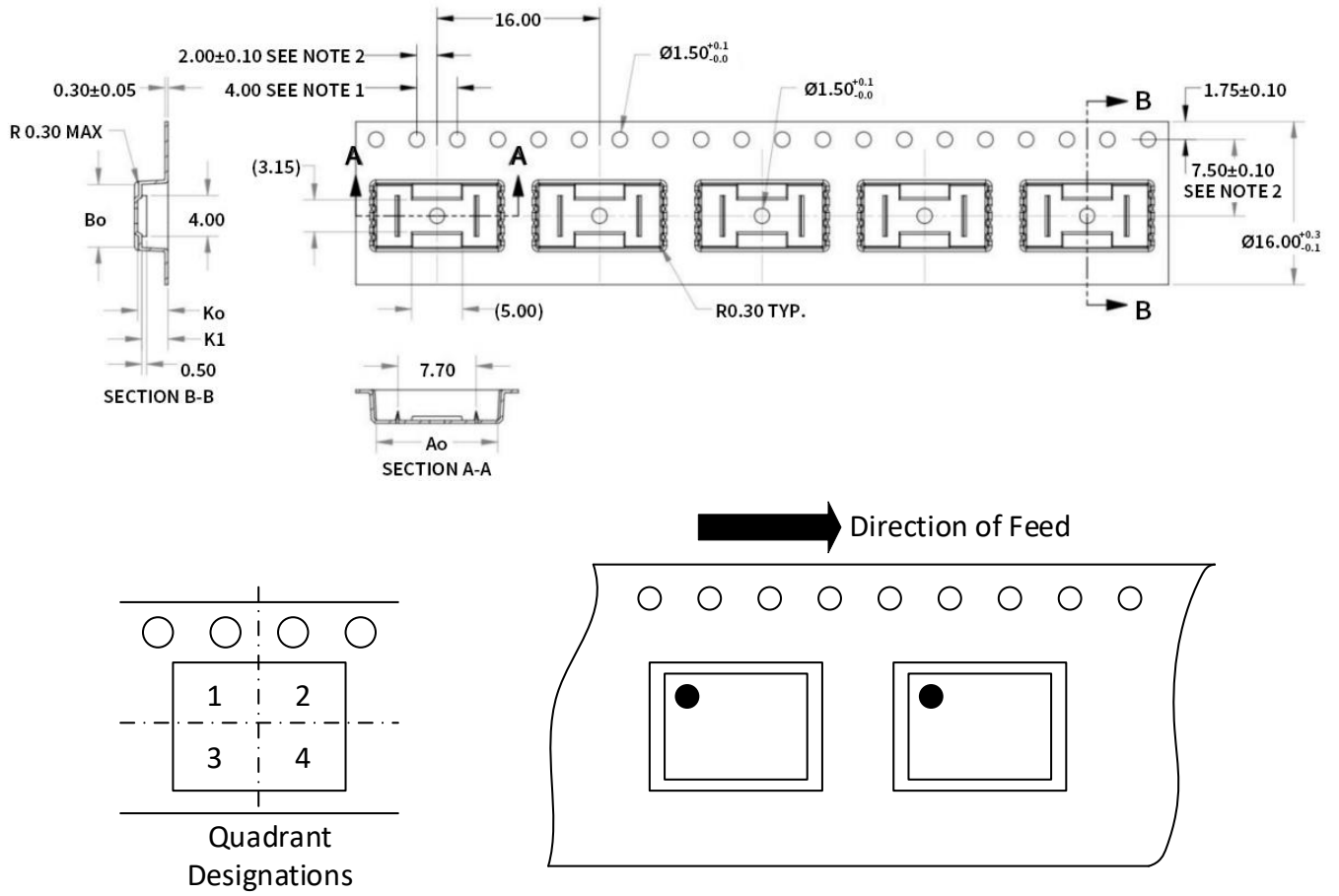
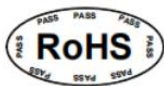
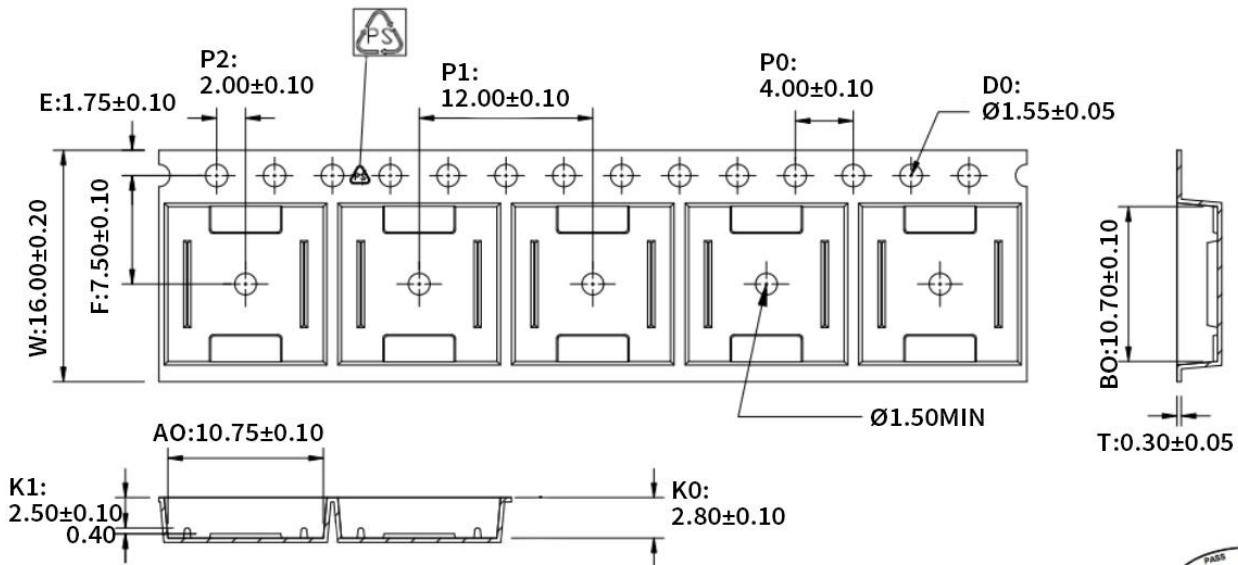


Figure 12.3 Tape Information of SOW8



- 1.10 sprocket hole pitch cumulative tolerance  $\pm 0.20$ .
2. Carrier camber is within 1 mm in 250 mm.
3. Material : Black Conductive Polystyrene Alloy.
4. All dimensions meet EIA-481 requirements.
5. Thickness:  $0.30 \pm 0.05$ mm.
6. Packing length per 22" reel: 378 Meters.(Rewind N=122 )
7. Component load per 13" reel: 1000 pcs.
8. Surface resistivity:  $10^5 \sim 10^{10} \Omega/\square$

W	16.00±0.20
A0	10.75±0.10
B0	10.70±0.10
K0	2.80±0.10
K1	2.50±0.10

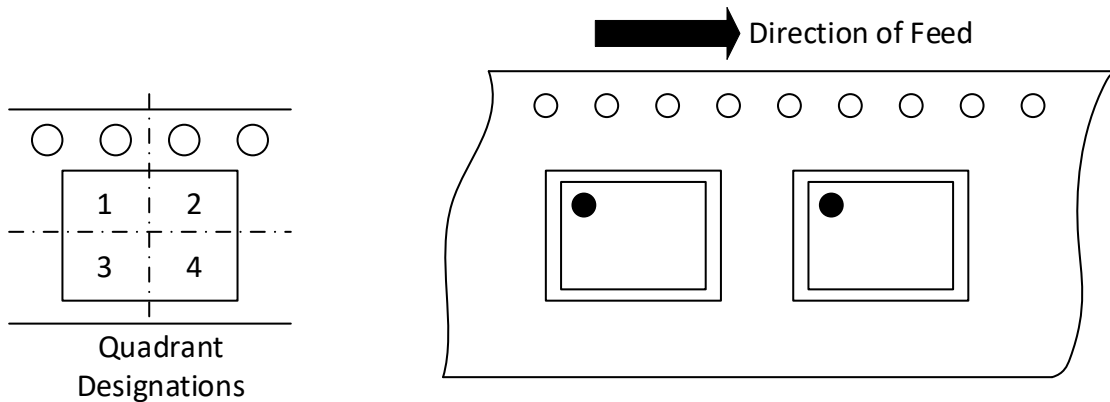


Figure 12.4 Tape Information of SOW16

### 13. Revision History

<i>Revision</i>	<i>Description</i>	<i>Date</i>
1.0	Initial version	2021/7/15
1.1	Update Insulation and Safety Related Specifications, add Thermal Derating Curve, add Junction Temperature, delete "Isolation barrier life: >60 years", add Thermal Characteristics sop8, update Regulatory Information VDE file	2022/9/7

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